

Remarks

All pending claims have been rejected under §112 and §102. In response, Applicant has rewritten all claims to overcome the technical rejections and define the invention patentably over the prior art.

Claim Rejections Under §112

The claims have been rejected under §112 because it is unclear how the "first predetermined limit" relates to the first predetermined voltage and second predetermined voltage. Applicant has rewritten all pending claims. In the new claims, it is clear that the high side switches are opened in response to either of the following events: 1) "when the rate of current flowing from the high side switches to the inductor exceeds a predetermined maximum" or 2) "when the output of the regulator exceeds a first predetermined voltage." The low side switches are opened "when the output of the switching regulator falls below a second predetermined voltage." As a result, it is clear that "predetermined maximum" refers to the amount of current flowing to the inductor and is not related to the first or second predetermined voltages.

Claim Rejections Under §102

The claims have been rejected under §112 as being clearly anticipated by Ashburn et al. (USP 6,362,608). In response, Applicant had rewritten all pending claims to require a switching regulator (or associated method) in which a series of high side switches and a series of low side switches are connected to a common inductor. The amount of current flowing through the inductor is determined by the number of active high and low side switches. The number of active switches is dynamically adjusted up or down in proportion to the load applied to the switching regulator.

Ashburn, on the other hand discloses a multiphase switching regulator implemented as a series of separate stages. Each stage has its own inductor connected to a high side switch and a low side switch. The outputs of the inductors (i.e., the separate stage outputs) are connected to a common output node. The stages operate in an interleaved fashion. A three stage implementation would activate stage one, followed by stage two, followed by stage three, followed by stage one and so on (1-2-3-1...). For cases where output voltage falls, a second mode is disclosed where all stages are active simultaneously.

Compared to the pending claims, Ashburn differs in the following key respects:

- 1) Ashburn does not disclose a switching regulator that uses a single inductor,
- 2) Ashburn does not disclose a switching regulator in which multiple high and low side switches are connected to a single inductor, and
- 3) Ashburn does not disclose a switching regulator in which the number of active high and low side switches is dynamically controlled in proportion to regulator load.

**Ashburn Does Not Disclose a Switching Regulator
That Uses a Single Inductor**

The switching regulators disclosed by Ashburn are multiphase regulators. They are constructed as multiple stages each having a high switch, a low side switch and an inductor. The use of multiple separate stages is intended to allow the stages to operate in an interleaved fashion with a net reduction in output ripple. This is structurally different from all of Applicant's claims which require a single inductor. The use of a single inductor is a key feature of the claimed switching regulator and greatly simplifies the use of that regulator in portable electronic devices or other environments where multiple inductors are difficult to accommodate.

**Ashburn Does Not Disclose a Switching Regulator
in Which Multiple High And Low Side Switches
Are Connected To a Single Inductor**

All of Applicant's claims require a device (or method) in which a single inductor is driven by multiple high and low side switches. The device disclosed by Ashburn, on the other hand, uses multiple inductors, each driven by a dedicated pair of high and low side switches. Ashburn's use of multiple inductors is required to support multiphase operation within that device. It is unsuitable to Applicant's claimed invention in which a single phase is repeated.

**Ashburn Does Not Disclose a Switching Regulator in Which the
Number of Active High And Low Side Switches Is Dynamically
Controlled In Proportion To Regulator Load**

All of Applicant's claims require a device (or method) in which the number of active switches is varied in proportion to regulator load. For a two switch implementation, the number of active switch varies between zero and two on a cycle by cycle basis to maintain regulator output. This is unlike Ashburn which discloses a regulator in which multiple stages operate in an interleaved fashion. During this type of operation, no more than one pair of high and low side switches are active at any time. (e.g., for a two switch implementation of Ashburn, exactly one switch is active during any phase).

Ashburn does disclose a "burst mode" in which all switches are activated. This mode is intended to allow the regulator to quickly respond to situations where the regulator output drops to an undesirable level. Unlike the regulator required by the current claims, the "burst mode" response of Ashburn is not

proportional. The number of active switches is not selected as a function of regulator load. Thus, for a three stage implementation, Ashburn would activate either one (normal mode) or three (burst mode) switches on each cycle. The device (or method) required by the claims would activate either zero, one, two or three switches. In use, the device described by Ashburn waits until output has dropped and then catches up by operating at full power. The presently claimed invention avoids the resulting output ripple by matching the number of active switches to the instantaneous load of the regulator. This provides a smoother output than is possible with the devices disclosed by Ashburn.

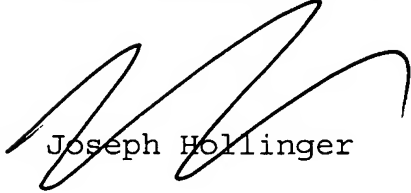
Conclusion

For all the above reasons, Applicant submits that the claims are now in proper form, and that the claims all define patentably over the prior art. Therefore they submit that this application is now in condition for allowance, which action they respectfully solicit.

Conditional Request for Constructive Assistance

Applicant has amended the specification and claims of this application so that they are proper, definite, and define novel structure which is also unobvious. If, for any reason this application is not believed to be in full condition for allowance, Applicant respectfully requests the constructive assistance and suggestions of the Examiner pursuant to M.P.E.P. § 2173.02 and § 707.07(j) in order that the undersigned can place this application in allowable condition as soon as possible and without the need for further proceedings.

Very respectfully,

A handwritten signature in black ink, consisting of several fluid, overlapping loops and strokes, positioned above the printed name.

Joseph Hollinger

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